INTERNATIONAL PARTNERSHIP FOR HYDROGEN AND FUEL CELLS IN THE ECONOMY

IPHE Country Update December 2018: United States

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1. New Initiatives, Programs, and Policies on Hydrogen and Fuel Cells

- Congress appropriated $120 million for the U.S. Department of Energy's (DOE) Fuel Cell Technologies Office (FCTO) within the Office of Energy Efficiency and Renewable Energy (EERE), along with $30 million for solid oxide fuel cells within the DOE's Office of Fossil Energy. These funds are for fiscal year 2019 and DOE is developing plans for future funding opportunity announcements. Congressional direction includes plans for industry-led efforts to demonstrate a hydrogen-focused integrated renewable energy production, storage, and transportation fuel distribution/retailing system.
- In August 2018, U.S. Secretary of Energy, Rick Perry, announced the selection of 28 projects totalling $38 million to support early-stage research and development (R&D) of innovative hydrogen and fuel cell technologies. This work also supports the DOE's H2@Scale Initiative to produce and use hydrogen across multiple energy sectors.
- The DOE's Loan Guarantee Program announced opportunities to help innovative energy, tribal energy, and advanced auto manufacturing projects overcome hurdles in obtaining loans to help bring new technologies to commercial deployment.
- The DOE released two Request for Information (RFIs) soliciting stakeholder feedback on opportunities addressing regulatory barriers to hydrogen infrastructure and on enabling high volume production and multi-sector use of hydrogen.
- California released the ***California Fuel Cell Revolution Report*** detailing their commitment to pursue a network of 1,000 hydrogen stations and 1,000,000 FCEVs by 2030.
- In August 2018, 6 new members were recently appointed to the federal advisory committee, Hydrogen and Fuel Cell Technical Advisory Committee (HTAC). HTAC was established to provide technical and programmatic advice to the Energy Secretary on the DOE's hydrogen research, development, and demonstration efforts. HTAC includes representatives from domestic industry, academia, professional societies, government agencies, financial organizations, and environmental groups.
- The U.S. was elected as Chair of the IPHE in May 2018.

2. Hydrogen and Fuel Cell R&D Update

- FCTO is currently cost-sharing over 20 R&D projects between industry, state governments, and the DOE's national laboratories in the areas of hydrogen production and grid integration, hydrogen infrastructure, hydrogen utilization, and hydrogen storage. These projects were selected as part of the ongoing H2@Scale initiative. Industry stakeholders include utilities, energy and industrial gas companies, and original equipment manufacturers. In total, projects have received over $10M in funding from

government, industry, and non-profits. For more information, please see **https://www.energy.gov/eere/fuelcells/h2-scale.**

- The DOE's Office of Fossil Energy has selected 18 projects to receive approximately $16.3 million in federal funding for cost-shared research and development (R&D) projects that will advance solid oxide fuel cell (SOFC) technologies. Links provided below.
- Published in May 2018, the ***2017 Annual Progress Report*** summarizes fiscal year 2017 activities and accomplishments by projects funded by the DOE Hydrogen and Fuel Cells Program.
- DOE is also updating its Multi-Year Research, Development and Demonstration Plans and technical targets and developing an H2@Scale roadmap.

3. Demonstration, Deployments, and Workforce Development Update

- As of September 2018, California has 36 open stations and plans to have 200 stations open by 2025. The Northeast corridor currently has 3 stations that have been built and 12-25 planned. Also in July 2018, Hawaii opened its first publicly accessible station.
- In November of 2018, Air Liquide announced plans to build the first hydrogen liquefaction plant in the U.S. specifically targeting hydrogen energy markets (e.g. fuel cell vehicles, material handling equipment). The plant will be 30 tonnes/day in capacity, will be located in the western region of the U.S., and will begin construction in 2019.
- At the beginning of November 2018, over 5,600 FCEVs had been purchased or leased.
- Currently, there are 33 fuel cell buses in operation, mostly in California, with over 30 additional buses planned, and more likely--based on state funding grants and transit agency plans.
- In the U.S., fuel cell forklift deployments continue to grow, with roughly 23,000 in operation and nearly 15 million hydrogen fuelings.
- In October 2018, the FCTO launched an interactive ***Hydrogen and Fuel Cells Career Map***. This tool promotes workforce development in the science, technology, engineering and math (STEM) field by making information about hydrogen and fuel cell technology careers, education requirements, and skills for each career easily accessible to the public.
- FCTO's projects on parcel delivery vans include FedEx and UPS. FedEx is currently operating the first fuel cell electric delivery van for on-road use in North America. Currently in use in New York, it has a standard delivery route delivering packages and doubling the range of pure battery electric vehicles. UPS is currently testing its prototype fuel cell/battery hybrid delivery truck and plans to demonstrate these trucks in California.

4. Events and Solicitations

- The DOE announced the Hydrogen and Fuel Cells Program 2019 Annual Merit Review and Peer Evaluation Meeting, to be held April 29 to May 1, 2019 in Crystal City, Virginia. Information available ***here***.
- The Hydrogen and Fuel Cell Technical Advisory Committee (HTAC) hosts periodic meetings for its members and other interested parties. The public is welcome to attend these meetings and make statements during the period for public comment. The next

meeting will be December 12-13, 2018 and March 19-20, 2019. **https://www.hydrogen.energy.gov/index.html**

- Several regional events and workshops including both federal, state and local entities and regional associations are planned throughout the year to focus on specific applications including rail, marine, etc.
- FCTO hosted the H2@Scale Consortium Kick-off Meeting on August 1st, 2018 in Chicago, Illinois along with senior DOE officials and Congressional Members. The objectives were to identify opportunities for hydrogen in the transportation, industrial, and power generation sectors, as well as to enable collaborations with industry, academia, and national lab stakeholders to advance H2@ Scale both nationally and regionally. The H2@ Scale Consortium now includes over 20 new projects between national labs and industry.
- The DOE and stakeholders held a series of communications and outreach activities throughout the month of October to commemorate National Hydrogen and Fuel Cell Day. Activities included interactive displays, educational 1.008 mile walks as well as public ride and drives. DOE Under Secretary for Energy drove a fuel cell car and authored a ***blog*** about his experience.
- On October 23rd, the U.S. DOE Deputy Secretary spoke at the Hydrogen Energy Ministerial Meeting 2018 hosted in Tokyo, Japan. Over 20 countries in attendance agreed on specific areas of collaboration in the ***Tokyo Statement***.

5. Investments: Government and Collaborative Hydrogen and Fuel Cell Funding

- DOE Loan Programs Office (LPO) announced a ***Loan Guarantee Solicitation*** which covers alternative vehicle fuel distribution facilities.
- As part of a recent $34 million ***announcement*** by DOE Secretary, Rick Perry, for Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) research and development projects, the Office of Energy Efficiency and Renewable Energy (EERE) will fund 87 new projects across 34 states, totalling nearly $13 million in funding, including 4 hydrogen and fuel cell projects.
- The Energy Department has announced the 2018 SBIR and STTR Phase I Release 1 Awards, including 15 projects focused on high density hydrogen storage, innovative ionomers in the catalyst layer, gas diffusion layers, and membranes for electrochemical compression of hydrogen. As a part of the SBIR/STTR FY 2019 Phase I Release 2, EERE ***announced 12 topics*** to fund more than 100 new projects, totaling approximately $20 million.
- The DOE announced a memorandum of understanding (MOU) with the U.S. Army to collaborate in the development of hydrogen and fuel cell technologies for military and civilian use. More info can be found here: **https://www.energy.gov/eere/articles/energy-department-and-army-tardec-collaborate-hydrogen-and-fuel-cells-military-use**

6. Regulations, Codes & Standards, and Safety Update

- Based on industry feedback, the stakeholder community has been exploring the potential for standard permits to streamline the permitting process for hydrogen fueling stations and reduce barriers.
- The DOE announced a new partnership between Pacific Northwest National Laboratory and the American Institute of Chemical Engineers, the ***Center for Hydrogen Safety*** (CHS). CHS is a global oriented non-profit dedicated to promoting hydrogen safety and best practices worldwide with access to 60,000 members in 110 countries.
- The DOE continues to support R&D to enable reduced liquid hydrogen station footprint and to address the restriction in certain regions of the use of fuel cell vehicles in tunnels.
- UN Global Technical Regulation (GTR) 13 Phase II work is ongoing. The next meeting of the working group is expected to be held in North America in March and will include reporting on the progress of the five task groups. The task group topics include medium- and heavy-duty vehicles and buses, fueling receptacles, recommendations for test procedures, and other topics.
- The International Code Council's 2018 Committee Action Hearings took place April 15-23, in Columbus, Ohio. The hearings addressed input on proposed code changes to the 2018 Group A International Codes®. Several proposals to the International Fire Code (IFC) which address fuel cells or hydrogen infrastructure were considered. They include adding appropriate references to National Fire Protection Association code, NFPA 2; correlating requirements with NFPA 855; modifying the requirements in Section 2309.4 so they apply for all hydrogen stations whether they are self-service or filling is done by an attendant; and several modifications to requirements for hydrogen vehicle repair garages and outdoor control areas. The results can be viewed here: **www.hydrogenandfuelcellsafety.info/s/2018-ICodes-HydrogenRelated-Results.pdf**.

Summary Country Update November 2018: United States

Transportation	Target Number	Current Status	Partnerships, Strategic Approach	Support Mechanism
Fuel Cell Vehicles[1]	1,000,000 by 2030 (CA goal)	Over 5,600 as of November 2018	Multiple state efforts and industry stakeholders	ZEV state mandate (currently implemented in CA, CT, MA, ME, MD, NJ, NY, OR, RI, and VT); state subsidies (rebates in CA, MA, CT etc.)
FC Buses	No target	More than 30 (in service in the US) 32 funded for CA in 2018	Federal Transit Authority (Department of Transportation); CARB; CEC, and multiple states	
Fuel Cell Trucks	No target	Prototype testing	CTE, FedEx Express, UPS, CEC, SCAQMD	ZEV state mandate (e.g. CA)
Forklifts	No target	>20,000	Early market applications strategy	
H_2 Refueling Stations	**Target Number**	**Current Status**	**Partnerships, Strategic Approach**	**Support Mechanism**
70 MPa On-Site Production	200 by 2025 in CA	~ 60 stations as of 11/18 (open,	State and private sector partnerships	

[1] Includes Fuel Cell Electric Vehicles with Range Extenders

70 MPa Delivered		constructed, or planned) 36 open public retail in CA		• California - $2.5 billion to build ZEV charging/refueling stations including 200 hydrogen stations (includes O&M grants) • ZEV mandate
35 MPa On-Site Production	No target	2 as of 11/2018 (bus only stations). 70 MPa stations include 35 MPa	2 stations for bus refuelling (California)	Solicitations from state and local agencies (e.g. South Coast Air Quality Management District Carl Moyer Memorial Air Quality Standards Attainment Program in California)
35 MPa Delivered	No target			
Stationary	**Target Number[2]**	**Current Status**	**Partnerships, Strategic Approach**	**Support Mechanism**
Small[3]	$1,000/kW for backup units running directly on hydrogen $1,500/kW for combined heat and power units running on natural gas	Negligible	Industry-led	State/regional

[2] Targets can be units installed and/or total installed capacity in the size range indicated

[3] <5 kW (e.g., Residential Use)

Medium[4]	No target	As of 5/2016, system capacity installed ~555 kW	Industry-led	State/regional
Large[5]	No target		Overall, more than 240 MW of large stationary (100 kW to multi-megawatt) fuel cells in the U.S.	State/regional
District Grid[6]	No target	As of 5/2016, system capacity installed ~25 MW	Industry-led	State/regional
Regional Grid[7]	No target	As of 10/23/2015, system capacity installed 30 MW	Industry-led	State/regional
Telecom backup	No target	As of 5/2017 >8,000 (including on order)	Industry-led	State/regional

[4] 5kW – 400 kW (e.g., Distributed Residential Use)
[5] 0.3MW – 10 MW (e.g., Industrial Use)
[6] 1MW – 30 MW (e.g., Grid Stability, Ancillary Services)
[7] 30MW plus (e.g., Grid Storage and Systems Management)

H_2 Production and Delivery	Target[8]	Current Status	Partnerships, Strategic Approach	Support Mechanism
Overall[9]	$4/kg (produced, delivered, dispensed) ultimately $7/kg by 2025, to supply early markets	~$5/kg-$10/kg (if state-of-the-art technologies were manufactured at high volume) $13-$16/kg (current price of hydrogen fuel in California, sourced primarily from natural gas reforming)	Limited government partnerships (commercial/industry focused)	State/regional funding and regulations (e.g. 33% of fuel sold from stations that are government-funded must be renewable in CA)
Water Electrolysis[10] (PEM, Alkaline, SOEC)	No target	Data collection in process	Continued government funding/cost share	State/regional(e.g. 33% renewables in CA)
By-product H_2	N/A	Not tracked		

[8] Target can be by quantity (Nm^3, kg, t) and by percentage of total production; also, reference to efficiency capabilities can be a target

[9] Hydrogen produced by reforming processes

[10] Please indicate if targets relate to a specific technology (PEM, Alkaline, SOEC)

Energy Storage from Renewables	Target[11]	Current Status	Partnership, Strategic Approach	Support Mechanism
Power to Power[12] Capacity	N/A	N/A	N/A	N/A
Power to Gas[13] Capacity	N/A	60-kW demonstration at UC Irvine began in 2016	In process	California Low Carbon Fuel Standard creates credits for use of low-carbon fuels. Blends of H2 and natural gas could receive credits under this regulation.

[11] Can be expressed in MW of Installed Capacity to use the electricity from renewable energy generation, and Annual MWh of stored energy capacity

[12] Operator has an obligation to return the electricity stored through the use of hydrogen back to electricity

[13] Operator has the opportunity to provide the stored energy in the form of hydrogen back to the energy system through multiple channels (e.g., merchant product, enriched natural gas, synthetic methane for transportation, heating, electricity)